THE GORGONACEA OF THE SIBOGA EXPEDITION

V. THE ISIDÆ

Siboga-Expeditie
XIII b²

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BY

C. C. NUTTING
Professor of Zoology, State University of Iowa

With 6 plates

(Aided by a grant from the ELIZABETH THOMPSON SCIENCE FUND)

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Family ISIDÆ.

Isis Linnæus. Hortus Cliffortianus, 1737.
Isis (in part) Pallas. Elenchus Zoophytorum, 1766, p. 220.
Isis (in part) Linnæus. Systema Naturæ, 12th Edition, 1767, p. 287.
Isis (in part) Ellis and Solander. Natural History of Zoophytes, 1786, p. 104.
Isis (in part) Esper. Die Pflanzenthiere, Vol. I, 1891, p. 277.
Isideæ (in part) Lamouroux. Hist. Polypes coral. flexibles, 1816, p. 458.
Isidinæ (in part) Milne Edwards and Haime. Hist. nat. des Coralliaires, Vol. I, 1857, p. 193.
Isidinæ Kölliker. Icones Histiologicæ, II, 1865, p. 140.
Isidæ + *Mopseadæ* + *Acanelladæ* + *Keratoisidæ* Gray. Catalogue of Lithophytes in the Collections in the British Museum, 1870, pp. 13, 16, 18, 19.
Isidæ Studer. Monatsbericht der königl. Akademie der Wissenschaften zu Berlin, 1878, p. 661.
Isidæ + *Ceratoisidæ* Verrill. Bulletin of the Museum of Comparative Zoology, Vol. XI, N° 1, 1883, p. 9.
Isidæ Studer. Versuch eines Systemes der Alcyonaria, 1887, p. 42.
Isidæ Wright and Studer. Challenger Reports, the Alcyonaria, 1889, p. 24.
Isidæ Bourne. A Treatise on Zoology, Part II, Chapter VI, 1900, p. 28.
Isidæ Hickson. National Antarctic Expedition, Vol. III, Coelentera Alcyonaria, 1907, p. 4.
Isidæ Nutting. Descriptions of Hawaiian Alcyonaria, 1908, p. 570.

The earlier writers usually included the species now allotted to the family *Melitodidæ* in the old genus *Isis*, thus involving the classification of the *Isidæ* in considerable confusion.

Kölliker (1865) with his usual clear insight, separated the "*Melithæacea*" and Isidinæ as distinct subfamilies of his Gorgonidæ, using the characters of the axis cylinder.

Gray (1870) established the families *Isidæ*, *Mopseadæ*, *Acanelladæ* and *Keratoisidæ*, all of which are now included in the single family *Isidæ*.

Studer (1887) gave a careful diagnosis of the family *Isidæ*, and divided it into the subfamilies *Ceratoisidinæ*, *Primnoisidinæ* and *Isidinæ*. Later (1889), in the Challenger Report, Wright and Studer defined the family as follows:

"Colony consisting of a simple or branched axis. The axis consists of calcareous and horny (internodal and nodal) regions; the branches when present arising from either the nodal or internodal regions, sometimes anastomosing; the axis solid or hollow, smooth, fluted or echinulate. The base of the axis calcareous and attached".

To avoid any confusion of certain species of the *Melitodidæ* with the *Isidæ*, this definition, although substantially correct, may be modified for the purposes of the present work as follows:

Gorgonacea with an axis composed of alternating calcareous and horny segments, the former being amorphous and not composed of a mass of agglutinated spicules, and the latter entirely horny without the admixture of definite calcareous spicules.

Several authors have proposed breaking up this family into subfamilies; but with the increase of our knowledge of the group this becomes increasingly difficult. Gray (1870) went to the extreme of placing the species now included in the *Isidæ* into four distinct families, viz. *Mopseidæ*, *Acanelladæ*, *Keratoisidæ* and *Isidæ*.

Verrill (1883) separates all but the genus *Isis* into a family *Ceratoisidæ*, which therefore includes Gray's *Keratoisidæ*, *Acanelladæ* and *Mopseidæ*. Studer (1887) divides the family into the subfamilies *Ceratoisidinæ*, *Primnoisidinæ* (including *Mopseidæ*) and *Isidinæ*. In their Report on the Alcyonaria of the Challenger Expedition (1889) Wright and Studer substitute the name *Mopseinæ* for Studer's subfamily *Primnoisidinæ*, and base the subfamilies of the *Isidæ* on the characters of the spicules.

The trouble with this arrangement is the intergrading features between the *Mopseinæ* and *Ceratoisidinæ*. In his discussion of the genera *Ceratoisis* and *Primnoisis*, which belong to the *Ceratoisidinæ* and *Mopseinæ* respectively, Hickson (1907) holds that these genera are not distinct, and proposes including both in the genus *Ceratoisis*. He says:

"The study of many specimens belonging to this family has convinced me that this subdivision is unnecessary and inconvenient. The many variations of spicule characters that are found in the species of a single genus render these structures unsatisfactory for the purpose of wide systematic differentiation. If we take a single species from each of two of the subfamilies and compare them, the differences observed in the character and arrangement of the spicules may seem to be of a higher rank than the usual differences between genera; while, on the other hand the examination of a large number of species of the same two genera will reveal so many of the intermediate conditions as to render the separation of the genera, on spicule characters alone, impossible. This kind of difficulty is particularly well seen in the case of the

genera *Ceratoisis* and *Primnoisis* which were placed by Professors WRIGHT and STUDER in the subfamilies *Ceratoisinæ* and *Mopseinæ*" [1].

This view is supported by an argument which should be read carefully by those interested in the discussion, but is too long to be quoted here. The present writer believes, however, that the family *Isidæ* was ably handled by WRIGHT and STUDER, and finds himself unable to agree with the eminent authority quoted above.

The intergradation of spicules is very wide spread among the Alcyonaria, and yet there are often certain dominant forms of spicules that are quite characteristic of definite groups, and therefore available for systematic purposes and form good zoological characters [2].

The spicules of the *Ceratoisidinæ* are of two general types. 1st. True spindles, either with verrucæ or comparatively plain or needle-like. These may be slightly forked or bifid at one end, but this does not alter their essential character. 2nd. Flattened spindles which are often bar-like with rounded ends, or with ends enlarged forming a lengthened hour-glass, or biscuit-form. These may approach the form of scales rather than of spindles. Even in such cases their edges are smooth, not ctenate nor with branched processes, although they may be beset with minute thorny points.

These spicules seem to me to be quite distinct from those found in the genus *Primnoisis*, which has the characteristic scales of the primnoid gorgonians, with branched processes or finely ctenate edges, often imbricating on the calyx walls.

This difference is strikingly shown in Plate IX of the Challenger Alcyonaria, where figures 1 to 5 represent spicules of *Acanella*, one of the *Ceratoisinæ*; and figures 6 to 11 all representing species of *Mopseinæ*. Or compare Plate Va, figures 1 to 9, all of *Ceratoisidinæ*, with Plate IX, figures 6 to 11, of spicules of *Mopseinæ*. It seems to the writer that it would be difficult to show greater contrasts than are found not only in these figures, but also in slides of spicules from specimens of *Ceratoisidinæ* on the one hand, and *Mopseinæ* on the other.

It is true that HICKSON's *Ceratoisis spicata* (loc. cit., p. 7) at first seems to form an intergrading link between these subfamilies; but it appears to me that this is more seeming than real. This writer describes the spicules, in part, as follows:

"The calyces are covered with an armature of overlapping scales, some of which are triradiate, others irregular in form".

According to this description and the figures none of these spicules show any real approach to the form of the characteristic spicules of *Ceratoisis*. Moreover the writer says:

"In the character of the axis it is closely related to *Primnoisis*".

The calyx spicules resemble closely some of the thorny scales of the primnoid genus *Caligorgia*, for instance.

The present writer, therefore, would place HICKSON's *Ceratoisis spicata* in the genus *Primnoisis*, calling it *Primnoisis spicata* (Hickson), and retain the subfamilies adopted by WRIGHT and STUDER, modifying, however, their subfamily diagnoses as follows:

Isidinæ: — Cœnenchyma thick; calyces inserted; spicules densely tuberculate spindles, oval radiate forms, heads, double heads, etc.

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[1] National Antarctic Expedition. Natural History, Vol. VII, Cœlentera Alcyonaria, 1907, p. 4.

[2] See the discussion of this point by the writer in his Report on the Muriceidæ of the Siboga Expedition, 1910, p. 5.

Ceratoisidinæ: — Cœnenchyma thin; calyces inserted, long, usually cylindrical; characteristic spicules in the form of spindles, or flattened bar-like of hour-glass forms which are smooth or with minute spiny points, never with true verrucæ; colony not profusely branched.

Mopseinæ: — Cœnenchyma thin; calyces usually exserted; often club-shaped; characteristic spicules flattened scales, often profusely branched or ctenate on their edges.

Systematic relationships of the family Isidæ.

The closest affinities of this family seem to be with the *Primnoidæ*, a fact which has been commented upon by several writers, the calcareous internodes of the former being apparently very similar in composition and structure to the calcareous axis of the latter. The cœnenchyma is usually thin in both families.

In the polyps and calyces of certain *Isidæ* we have a very striking similarity to those of the *Primnoidæ*, and this is particularly true in the case of the new genus *Peltastisis* described in this Report. Here the form of the calyx, the form and arrangement of the spicules, the reduction in the number of adaxial scales, and the essential character of the operculum (a scale to each segment) are all typically primnoid in their nature. Were it not for the jointed axis of *Peltastisis* I doubt if any one would hesitate in putting it in the family *Primnoidæ*.

Indeed the character of the axis alone can be successfully used in separating these two closely related families.

On the other hand, the *Isidæ* show many characters in common with the sclerogorgian family *Melitodidæ*. These families can not be separated on the characters of the spicules, for those of the *Isinæ* show the same general characters as are common in the *Melitodidæ*. The nodes and internodes are superficially much alike in the two families, and the calcareous internodes are in some cases, particularly in the older parts of the colony, apparently almost as completely calcareous and amorphous in the *Melitodidæ* as in the *Isidæ*. It was formerly held that both nodes and internodes of *Melitodidæ* were penetrated by solenia; but this is now denied [1]. Here, again, the characters of the axis seem to afford the only reliable means of family differentiation, the horny nodes of the *Melitodidæ* being always more or less mixed with calcareous spicules, while those of the *Isidæ* are purely horny, without spicules.

The writer desires to emphasize an opinion elsewhere expressed [2] as follows:

"Our knowledge of the lower invertebrates is still far too fragmentary to permit us to indulge the hope that our work as systematists will really serve to express in final form the actual relationships of any large group of animals.

While a natural classification is a 'consummation devoutly to be desired' we are not yet, it seems to me, in sight of it".

The main service of classification, in our present state of knowledge, is to facilitate identification of groups, the final result being facility in determination of species.

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[1] Bourne. A Treatise on Zoology, Part II, Chapter VI, p. 28, 1900.

[2] The Gorgonacea of the Siboga Expedition, III, The Muriceidæ, 1900, p. 9.

Key to the genera of the Isidæ.

(Generic names enclosed in brackets indicate that such genera are not represented in the Siboga collection).

Isidinæ:

Spicules densely tuberculate spindles, calyces included. . . . . **Isis**

Ceratoisidinæ:

Calyces not uniserial, and with a crown of points formed by large, needle-like spicules.

Colony simple; or, if branched, with branches springing from the calcareous internodes.

Calyx with an external layer of flattened, bar-like spicules with rounded ends . . . . . (**Lepidisis**)

Calyx with spindles or needles only . . . . . **Ceratoisis**

Colony branched, branches arising from horny nodes . . . . . **Acanella**

Calyces sometimes uniserial, without a crown of points.

Colony unbranched; calyces uniserial. . . . . (**Bathygorgia**)

Colony branched, branches from calcareous internodes.

Coenenchyma with spicules . . . . . (**Callisis**)

Coenenchyma without spicules . . . . . (**Sclerisis**)

Branches from horny nodes . . . . . (**Isidella**).

Mopseinæ:

Calcareous internodes with serrated ridges. . . . . (**Acanthoisis**)

Calcareous internodes without serrated ridges.

Calyces uniserial, with true opercula . . . . . **Peltastisis**

Calyces not uniserial, no true opercula.

Spicules of calyx ctenate scales, or with thorny points . . . . **Mopsea**

Spicules of calyx spindles, with true verrucæ . . . . . (**Chelidonisis**) [1]

Synoptic view of the genera and species of Isidæ secured by the Siboga.

* The asterisk (*) denotes a new species.

Isidinæ.

Isis.

I. hippuris, *I. *reticulata.*

Ceratoisidinæ.

Ceratoisis.

C. paucispinosa, *C. philippinensis*, *C. *wrighti*, *C. sp.?*

Acanella.

*A. *sibogæ*, *A. *weberi*, *A. sp.?*

Mopseinæ.

Mopsea.

*M. *flava*, *M. *alba.*

Peltastisis.

*P. *uniserialis*, *P. *cornuta.*

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[1] This form shows affinities with the *Isidinæ* in the form of its spicules, which are much like those of *Isis hippuris*; but has a rather thin cœnenchyma and evident calyces, characters which allie it with the *Mopseinæ*. See Studer, Alcyonaires provenant des Campagnes de l'Hirondelle, 1901, p. 39 and Plate Iv, fig. 9.

It will be seen from the table that of the thirteen species collected, three were previously known, two are represented by material insufficient for identification, and eight are described as new.

Systematic description of genera and species of Isidæ of the Siboga collection.

Isidinæ. (See the definition of this subfamily on p. 3).

Isis Linnæus.

Isis (in part) Linnæus. Hortus Cliffortianus, 1737, p. 479.
Isis (in part) Linnæus. Systema Naturæ, 1758, p. 1287.
Isis (in part) Pallas. Elenchus Zoophytorum, 1766, p. 220.
Isis (in part) Ellis and Solander. Natural History of Zoophytes, 1786, p. 104.
Isis (in part) Esper. Die Pflanzenthiere, Vol. I, 1791, p. 27.
Isis Lamouroux. Hist. Polypes coral. flexibles, 1816, p. 4687.
Isis Lamouroux. Exposition Méthodique, 1821, p. 39.
Isis Lamarck. Hist. Nat. Anim. sans Vert., 1836, p. 473.
Isis (in part) Milne Edwards et Haime. Hist. nat. des Coralliaires, Vol. I, 1857, p. 193.
Isis Gray. Proceedings Zool. Society of London, 1857.
Isis Kölliker. Icones Histiologicæ, II, 1865, p. 140.
Isis Dana. Synopsis Report on Zoophytes of the Wilkes Expedition, 1859, p. 144.
Isis Studer. Versuch eines Systemes der Alcyonaria, 1887, p. 46.
Isis Wright and Studer. Challenger Reports, the Alcyonaria, 1889, p. XLV.
Isis Thomson and Simpson. Alcyonarians of the Indian Ocean, II, Alcyonarians of the Deep Sea, 1909, p. 180.

The original genus *Isis* included not only all of the present *Isidæ*, but also certain of the *Melitodidæ*, and resulted in the same confusion as in the synonymy of the family *Isidæ*. Lamouroux (1816) appears to have used the name in almost its modern signification; but subsequent writers included many other forms, until Gray (1857) restricted the genus. Kölliker (1865) was the first to carefully describe the spicules and use them in his generic definition, and subsequent writers have used the name as understood in the present work.

This being the only genus of the subfamily *Isidinæ*, the definition already given for the *Isidinæ* will serve for the genus.

The type species of this genus is *Isis hippuris* Linn., and the only other known species in the *Isis reticulata* described beyond.

1. *Isis hippuris* Linnæus. (Plate I, figs. 1, 1*a*, 1*b*; Plate V, fig. 1).

Isis hippuris (in part) Linnæus. Systema Naturæ, 12th Edition, p. 1287.
Isis hippuris (in part) Pallas. Elenchus Zoophytorum, 1766, p. 233.
Isis hippuris Ellis and Solander. Natural History of Zoophytes, 1786, p. 105.
Isis hippuris (in part) Esper. Die Pflanzenthiere, Vol. I, 1791, p. 279.
Isis hippuris Lamouroux. Histoire Polypiers coralligènes flexibles, 1816, p. 476.
Isis hippuris Lamouroux. Exposition Méthodique, 1821, p. 39.
Isis hippuris Lamarck. Histoire Naturelle des animaux sans vertèbres, 1836, p. 475.

Isis hippuris Milne Edwards et Haime. Histoire nat. des Coralliaires, Vol. I, 1857, p. 194.
Isis hippuris Steenstrup. Om slaegter og de under *Isis hippuris* Linn. sammenblendede Arten, 1848, p. 1.
Isis hippuris Kölliker. Icones Histiologicæ, II, 1865, p. 140.
Isis hippuris Thomson and Simpson. Alcyonarians of the Indian Ocean, II, 1909, p. 180.

Stat. 71. Makassar and surroundings. Up to 32 meters. Mud, sand with mud, coral.
Stat. 133. Anchorage off Lirung, Salibabu-Island. Up to 36 meters. Mud and hard sand.
Stat. 142. Anchorage off Laiwui, coast of Obi Major. 23 meters. Very fine hard sand, mud.
Stat. 144. Anchorage North of Salomakiëe (Damar) Island. 45 meters. Coral bottom and Lithothamnion.
Stat. 149. Fau Anchorage and lagune. West coast of Gebé Island. 31 meters. Coral.
Stat. 258. Tual Anchorage, Kei Islands. 22 meters. Lithothamnion, sand and coral.
Stat. 279. Rumah-Kuda Bay, Roma Island. 36 meters. Mud and sand.
Stat. 301. 10° 38′ S., 123° 25′.2 E. 22 meters. Mud, coral and Lithothamnion.
Stat. 303. Haingsisi, Samau Island. Up to 36 Meters. Lithothamnion.

Colony (incomplete) 28 cm. in height, growing in a densely aggregated mass of branches which are individually composed largely of tufts of branchlets. Main stem, or branch, round in section, about 1 cm. in diameter. The main branches are lateral in position, often flattened proximally in the plane of ramification. The secondary branches are usually lateral in position and often bear terminal twigs which are swollen, round and pointed at the ends.

The cœnenchyma is very thick and fleshy, and does not show any external evidence, in alcoholic specimens, of the jointed axis. The calyces are entirely included, and are distributed on all sides of the stem and branches, much as in the *Plexauridæ*. Their openings are almost completely concealed, appearing only as minute depressions in the general surface of the branches, the openings being no larger than pin holes. In color and appearance the colony greatly resembles a profusely branching *Millepora*, the fine pits closely resembling the gastropores of the latter. The polyps are very minute and entirely retracted, so that little of their structure could be ascertained without sectioning. The surface is quite smooth, the spicules not being evident on account of their small size.

A cross section of a branch reveals a very thick cœnenchyma in which the relatively small calyces are embedded. The cœnenchyma is filled with a dense mass of small spicules. Around the axis is a series of very large watervascular canals, their number being very often eight in the smaller branches. The axis is composed of alternate horny and calcareous joints, the latter being the longer and larger, being 1 cm. in diameter in the specimen described. Their length is about 1 cm., and this does not vary greatly even in the distal branchlets.

These calcareous internodes are strongly fluted longitudinally, the grooves being the impressions of the primary watervascular canals. The horny nodes are much shorter, not exceeding 3 mm. in the specimen described, and having a diameter of 5 mm. where the adjacent calcareous joints are 1 cm. long. The branches usually arise from the calcareous nodes, but bifurcations usually take place upon the distal ends of horny joints.

A cross section of a calcareous internode about 5 mm. in diameter shows a central amorphous area surrounded by a darker line, like a line of growth, enclosing a figure with eight concave sides, beyond this, at varying distances, are other similar lines enclosing figures of more than eight concave sides, the outer lines being closer together than the others. While

the calcareous substance of the axis shows a crystalline appearance, there are no indications that it is composed of fused spicules. The concave sides of the cross section correspond, of course to the grooves for the primary canals, and the number eight seems significant as being the original number of these canals, corresponding to the eight intermesenterial chambers of the primary polyp of the colony or branch. The central area is marked by an axial nuclear spot, from which many lines radiate toward the periphery of the area

The horny nodes are hour-glass shaped, in longitudinal section, their ends being concave for the insertion of the convex ends of the calcareous internodes. At the line of juncture there is an irregular mass of horny projections alternating with the calcareous material, giving an anchorage that binds the node and internode together. There are no calcareous spicules in the nodes.

Spicules. These are all quite small, and of several forms. All are modifications of short tuberculate spindles. Double spindles, dumb-bell shapes, double heads, crosses and densely tuberculate oval forms predominate. All are closely tuberculate, and most of them show a median, constricted smooth girdle. There are a few double crosses and spindles with regular whorls of tubercles.

Color. The specimens in alcohol are a tan brown, the dried specimens being darker brown. Axis white, with the horny nodes dark horn brown.

General distribution. This species has been reported from the Indian Ocean, and parts of the tropical eastern Pacific. The form reported from the Mediterranean is in all probability not this species or genus.

This species is quite variable, and specimens differ much according to size and age, the larger stems and branches having the "moniliform" appearance that has led some authors to describe several species on the basis of what appears to be merely varietal differences.

Many of the dried specimens were originally much larger than the one described; but, owing to their excessive brittleness, they are so badly broken up that the original dimensions can not easily be ascertained.

2. *Isis reticulata* new species. (Plate I, figs. 2, 2*a*; Plate V, fig. 2).

Stat. 273. Anchorage off Pulu Jedan, East coast of Aru Islands. 13 meters. Sand and shells.

Colony much broken up, the specimens consisting of large and small fragments all from the same station. General habit loose and straggling, much less inclined to the formation of dense tufts than in *Isis hippuris*. The thickest stem found is 7 mm. in diameter, and the horny internodes are almost entirely obliterated, being indicated by darker color alone. The longitudinal grooves are continuous over the calcareous and horny joints, the latter being but slightly constricted. The first calcareous internode is 1 cm. long, the next 1.6 cm., the next 2 cm., and bearing a branch a little above its middle. Further up the horny nodes are sharply constricted, clearly defined and about 2 mm. in length. The branching is straggling, and there are occasional anastomoses of branches. There is a distinct tendency toward a flabellate form of colony. The

distal branches are much longer and more slender than in *Isis hippuris*, sometimes attaining a length of as much as 17 cm., while their diameter is only 2 mm. The terminal twigs are not swollen at the ends, in marked contrast to *I. hippuris*.

The calyces are entirely included, very small, and sparsely and irregularly distributed on all sides of the branches. The polyps are partially expanded in the specimen described, making it difficult to ascertain the form and size of the apertures. Where the polyps are fully retracted the surface of the branch is perfectly smooth, with little or no indication of the calyx openings. The polyps themselves are small and appear to be devoid of spicules, both in body walls and tentacles. Consequently they are very soft and flabby, and are usually prone against the cœnenchyma of the branches when expanded in alcoholic specimens.

Spicules. The spicules are minute, smaller than in *Isis hippuris*, and distinctly different in shape, being much more delicate spindles with tubercles often symmetrically disposed around the main axis. Irregular branched forms are common. Crosses are more rarely seen, and also a few curved spindles with large tubercles. A comparison of a slide of spindles from *I. reticulata* with one from *I. hippuris* shows a very distinct difference in the assemblage of forms of the two species.

Color. The entire colony, in alcohol, is reddish brown. The polyps are more distinctly reddish than the cœnenchyma, sometimes approaching a maroon.

The species seems quite distinct from *Isis hippuris*, from which it differs in manner of branching, reticulation, slenderness of twigs, color, and most of all in the character of the spicules.

Ceratoisidinæ. (For definition of subfamily see p. 4).

Ceratoisis Wright.

Keratoisis E. Percival Wright. Annals and Magazine of Natural History, 4th Series, Vol. II, 1868, p. 427. (Name only).
Keratoisis E. Percival Wright. Annals and Magazine of Natural History, 4th Series, Vol. III, 1869, p. 23.
Keratoisis Gray. Catalogue of Lithophytes in the British Museum, 1870, p. 18.
Keratoisis Studer. Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin, 1878, p. 662.
Ceratoisis Verrill. Bulletin Museum of Comparative Zoology, Vol. XI, 1883, p. 10.
Ceratoists Wright and Studer. Challenger Reports, the Alcyonaria, 1889, p. 26.
Ceratoisis (in part) Hickson. National Antarctic Expedition. Natural History, Vol. III, Cœlentera Alcyonaria, 1907, p. 5.
Ceratoisis Nutting. Hawaiian Alcyonaria, 1908, p. 570.

The original description of this genus is as follows:

"Coral branched, irregularly furcate; axis jointed, composed of horny and calcareous portions; the latter are hollow, smooth, varying considerably in length, and maintaining their form after maceration in caustic alkalies; the branches are given off from the calcareous portions. The so-called "barky layer" (cœnenchyma) is well developed, and contains a large number of calcareous spicules. The polyps are irregularly and somewhat densely grouped all around the

axis; they are of large size and are completely covered with spicules, which are closely packed side by side. A variable number (nine to eleven) of long fusiform spicules surround the apical portion of the polype, forming a calyx. Tentacles eight, pinnately lobed".

VERRILL includes in this genus all of his family "*Ceratoisidæ*" that have the cœnenchyma and calyces filled with large fusiform spicules and the calyx armed with a crown of spines. This definition is somewhat misleading, as the small spicules often found in the calyces and cœnenchyma are often not fusiform but lenticular or "biscuit-shaped", sometimes fiddle-shaped, or even oval.

STUDER (1887) practically adopts the original definition of WRIGHT. WRIGHT and STUDER (1889) point out the difficulty of distinguishing between the unbranched species of *Lepidisis* (Verrill) and the unbranched forms of *Ceratoisis*. This point seems to the present writer to be well taken, and should result in the combination of the two genera, as suggested by WRIGHT and STUDER.

Their definition of the genus *Ceratoisis* is as follows:

"The colony is simple or branched, in the latter case with the branches arising from the calcareous internodes. These latter are long and hollow when young. The cœnenchyma contains long smooth spindles or needle-like spicules. In the polyps, which are nonretractile, there are large needles. One row of these spicules is so disposed that one lies at the base between each pair of tentacles and projects beyond them, the result being a circlet of diverging spines around the oral region".

This definition is dificient in the fact that it makes no mention of the oblong, comparatively smooth, oval, or lenticular spicules found both in *Ceratoisis grayi* (the type species) and in the species of VERRILL's genus *Lepidisis*. This point, however, is covered in their more elaborate definition of the genus on page 26 of the Challenger Report, Alcyonaria, 1889.

The genus *Ceratoisis*, as used in the present work, may be defined as follows:

Ceratoisidinæ whose calyces are armed with a crown of needle-like spicules. The axis is simple or sparingly branched, the calcareous internodes hollow, at least in the younger portions of the colony. Cœnenchyma, and often the calyces, with oblong, lenticular, fiddle-shaped, or oval scales with comparatively smooth surfaces.

The type species of this genus is *Ceratoisis grayi* Wright. Other species are *C. (Lepidisis) caryophyllia* (Verrill), *C. flabellum* Nutting, *C. gracilis* Thomson and Henderson, *C. grandiflora* Studer, *C. grandis* Nutting, *C. (Lepidisis) inermis* (Studer). *C. japonica* Studer, *C. (Lepidisis) longiflora* (Verrill), *C. nuda* Wright and Studer, *C. ornata* Verrill, *C. palmæ* Wright and Studer, *C. philippinensis* Wright and Studer, *C. ramosa* Hickson, *C. siemenensis* Studer, *C. (Lepidisis) vitrea* (Verrill), and the new species described in the present work.

1. *Ceratoisis paucispinosa* Wright and Studer.

Ceratoisis paucispinosa Wright and Studer. Challenger Reports, the Alcyonaria, 1889, p. 28.

Stat. 52. 9° 3′.4 S., 119° 56′.7 E. 959 meters. Globigerina ooze.

Specimens consisting of two fragments, probably from the same stem. The largest of these includes the base of the colony consisting of large thin, plate-like calcareous lobes, but one of which is complete. This is 2.6 cm. long. The fragment has an entire length of 26 cm. The first internode above the base is the shortest, being 3.5 mm. long. The next is 1.7 cm., the next 3.1 cm. the next 4.3 cm., the next 4.5 cm., and the remaining three gradually diminish in size. The diameter at base is 3 mm., at distal end 1.5 mm. The longest horny node is the third, which is 3 mm. long, and their length diminishes to the distal node which is 1.4 mm. The surfaces of the internodes are marked by shallow longitudinal furrows. The other fragment is nearly 18 cm. long, much more slender than the first, and the length of the internodes varies from 1 cm. to 2.9 cm. The specimens are so mutilated that the arrangement of the calyces can not be determined, further than that they appear to be borne on all sides of the stem.

The individual calyces are excessively long and slender. It is possible that the specimen has been dried at some time, and that the polyps have been shrivelled so as to be more slender than they were originally. A typical calyx is 8 mm. long to the top of the marginal spines, 2.2 mm. in diameter at margin, and 1.1 mm. at the narrowest part of the pedicel, near the middle. There are a few slender, needle-like spicules on the proximal part of the calyx, especially on the abaxial side, and a series of 8 very long, sharp smooth spindles with their points projecting far beyond the margin, forming a crown of points. There are a few needle-like spindles in the cœnenchyma near the polyp bases. Otherwise the cœnenchyma is rather leathery and almost devoid of large spindles. But there are numerous comparatively minute bar-like spicules near the surface of the cœnenchyma, and a few minute spicules in the tentacles.

Spicules. These are long sharp needles, and small bar-like forms. The former sometimes attain a length of 5 mm., and are usually sharp at both ends. Their surface is studded with numerous small sharp thorn-like points. The largest of these needles form the marginal crown of points. The bar-like forms in the cœnenchyma are minute, rather short bars, with their ends somewhat expanded and rounded.

Color. The colony is ivory white (in alcohol), and the polyps are very light brown.

General distribution. The type locality is off the Hyalonema Grounds, Japan, 343 fathoms.

A comparison with polyps of the Challenger type shows that the Siboga specimens have nore slender calyces, due probably to drying. The original description says that the cœnenchyma is without spicules. These are minute, and might escape observation.

2. *Ceratoisis philippinensis* Wright and Studer.

Ceratoisis philippinensis Wright and Studer. Challenger Reports, the Alcyonaria, 1889, p. 27.

Stat. 52. 9° 3′.4 S., 119° 56′.7 E. 959 meters. Globigerina ooze.
Stat. 122. 1° 58′.5 N., 125° 0′.5 E. 1264—1165 meters. Stone.
? Stat. 173. 3° 27′ S., 131° 0′.5 E. 567 meters. Fine yellow grey mud.
? Stat. 178. 2° 40′ S., 128° 37′.5 E. 835 meters. Blue mud.

Specimens consisting of two unbranched fragments, the longest being 13.6 cm. in length.

The longest calcareous internode is 6.1 cm. long, while the horny nodes are but 1 mm. long. The shorter fragment has a thicker axis than the other, their diameters being 2 mm. and 1.8 mm. respectively. Both are largely denuded of cœnenchyma, but retain this and the polyps in places. The calyces are rather closely set in irregular spirals, being on all sides of the stem or branch.

The individual calyces are columnar in shape and usually project at a wide angle from the stem. A typical one is 4.5 mm. in height and 2.5 mm. in diameter. The walls are nearly straight. There are a few transversely disposed spindles near the base, and a row of about eight long spindles extending perpendicularly from the transverse spicules to beyond the margin, around which they form a crown of points. Shorter spindles support the larger ones near the base, as if propping them. The dorsal surfaces of the tentacles are armed with two or three rows of bar-like spicules longitudinally disposed.

The cœnenchyma of the stem is thin and stripped from most of the specimens. It contains a few spicules in the form of spindles.

Spicules. These are nearly all slender spindles, pointed at the ends and attaining a length of 3. mm. They differ from the others described in having their surfaces almost perfectly smooth, without verrucæ or projecting points of any kind, thus resembling most of the spicules of the pennatulids. The largest of these spicules are those forming the crown of points around the calyx margins. Besides these spindles, there are a few bar-like forms with rounded ends, found in the tentacles.

Color. The specimens are ivory white, in alcohol. The nodes are dark brown, and the polyps very light brown.

General distribution. The type locality is Challenger Station 201, off the Philippines; depth 82 fathoms; bottom, stones.

This species is also found in the Japanese waters: (NUTTING, Mss.).

The specimen described is labeled "*Ceratoisis philippinensis*". This was very likely written by Dr. VERSLUYS during his preliminary studies of the *Gorgonacea* of the Siboga Expedition. Through his kindness the writer has been permitted to examine fragments of the Challenger types of this species. These agree fairly well with the above description; but differ considerably from the description in the Challenger Report, having calyces in some instances 5 mm. in height, and with the spiculation as described above. The small spicules are more numerous than in the Siboga material, and the color of the calyces is much darker. The calcareous internodes are longer in the Siboga material than the descriptions of the type would indicate.

3. *Ceratoisis wrighti* new species[1]. (Plate II, figs. 1, 1*a*; Plate V, fig. 3).

Stat. 87. 0° 32′ S., 119° 39′.8 E. 655 meters. Fine grey mud.

Colony over 1 meter in length (113 cm.), unbranched. The base consists of two very

[1] Named in honor of E. PERCIVAL WRIGHT who first defined the genus *Ceratoisis*.

long, expanded, lobular limestone processes, extending laterally from the bottom of the stem. One of these processes is nearly 5.6 cm. in length, and 5 mm. wide at its broadest point. The greatest diameter of the axis, near base, is 3.3 mm. The shortest (basal) internode is 3.5 mm. long, and the longest (4th from base) 3.3 cm. The horny nodes are short, and the longest (basal) one is 3 mm. in length. Average length about 1 mm. The polyps are biserially arranged, in general, although this is occasionally interfered with by one situated on the front or back of the colony. They all curve upward toward the distal end of the colony, with their adaxial sides almost contiguous with the cœnenchyma of the stem; the summit of one reaching to, or slightly beyond, the base of the one next above.

The individual calyx is columnar or cylindrical in form, but many are swollen with ova in their proximal portion. A typical one is 6 mm. in height to the end of the crown of points, and 2.5 mm. broad at the slightly expanded margin. There is usually one conspicuous, needle-like spicule placed vertically in the abaxial side of the calyx, reaching nearly from the base to the summit, but ordinarily not projecting beyond the margin, and attaining a length of 5 mm. There are also eight vertical spicules in the distal part of the calyx wall, whose points form a conspicuous crown, as in *C. paucispinosa*. Aside from these there are very few if any spicules in the calyx walls. Spicules appear to be wanting both in the tentacles and the general cœnenchyma of the stem, which is quite thick and fleshy.

Spicules. I find but the one kind, the slender, needle-like form described above as occurring in the calyx walls. Their surface is covered with regular, but rather sparsely disposed, minute, thorny points.

Color. The colony, when the cœnenchyma and the calyces have not been stripped from the stem, is a rather bright reddish brown. The axis is pure white, except at the nodes, which are dark brown.

This fine species differs from *C. paucispinosa*, its nearest ally, in length of calcareous internodes, size and disposition of polyps, and in the spiculation, being without spicules in the tentacles and cœnenchyma. It differs from *C. nuda* Wright and Studer in size of spicules, and in having no tentacular spicules, as well as in size of internodes.

4. *Ceratoisis sp.*?

Stat. 122. 1°58′.5 N., 125°0′.5 E. Between Menado and Biaru Island. 1264—1165 m. Stony bottom.

A fragment of denuded axis from Station 122 differs from all the other species in the collection in the length of the single calcareous internode which is 9.9 cm. long and has a diameter of 2.5 mm. The surface is regularly but not deeply furrowed or fluted longitudinally. The horny node is 23 mm. long.

The axis approaches the characters of *Ceratoisis grandis* Nutting from Hawaiian waters[1], which has internodes up to 14 cm. in length. The writer, however, does not feel justified in identifying species on the characters of the axis alone.

[1] Proceedings of the U. S. National Museum, Vol. XXXIV, p. 570, 1908.

Acanella Gray (emended by Verrill).

Acanella Gray. Catalogue Lithophytes in British Museum, 1870, p. 16.
Acanella Verrill. Bulletin Museum of Comparative Zoology, Vol. XI, N⁰ 1, 1883, p. 13.
Acanella Studer. Versuch eines Systemes der Alcyonaria, 1887, p. 44.
Acanella Wright and Studer. Challenger Reports, the Alcyonaria, 1889, p. 29.
Acanella Nutting. Hawaiian Alcyonaria, 1908, p. 572.

Verrill's definition of the genus is as follows:

"Coral either simple or variously branched. Axis with long calcareous joints and very short horny ones. The branches, where they exist, arise from the horny joints, either singly, or two or more together, often forming a whorl. Cœnenchyma very thin, containing, more or less abundantly, elongated fusiform spicula, usually of large size. Calicles large, elongated, composed of large fusiform spicula, often obliquely arranged; the margin is armed by eight long, spine-like, projecting acute spicula. Tentacles stiffened by abundant spicula. Base, in most cases, divided into large, flat, palmate lobes, which descend into the mud and serve as supporting roots or anchors".

Studer (1887) gives a condensed definition, retaining the essential points as given by Verrill.

Wright and Studer (1889) retain the definition of Verrill, somewhat condensed, with the additional point that the basal internodes are much shorter than the distal. For the purposes of this work the following definition is offered for the genus *Acanella*:

Ceratoisidinæ, simple or branched, with branches arising from the horny nodes, often in whorls. Calyces prominent, with a crown of marginal points. Tentacles with minute spicules. Cœnenchyma thin, with fusiform spicules. All spicules have thorny points, but are without true verrucæ.

The type species of this genus is *Acanella arbuscula* (Johnston). Other known species are *Acanella eburnea* (Pourtalès), *A. chiliensis* Thomson and Henderson, *A. gregorii* Gray, *A. normani* Verrill, *A. rigida* Wright and Studer, *A. robusta* Thomson and Henderson, *A. simplex* Verrill, *A. spiculosa* Verrill and the additional species about to be described.

1. *Acanella sibogæ* new species. (Plate III, figs. 2, 2*a*; Plate V, fig. 4).

Stat. 85. 0° 36′.5 S., 119° 29′.5 E. 724 meters. Fine grey mud.
Stat. 170. 3° 37′.7 S., 131° 26′.4 E. 924 meters. Fine grey mud.
Stat. 178. 2° 40′ S., 128° 37′.5 E. 835 meters. Blue mud.
Stat. 211. 5° 40′.3 S., 120° 45′.5 E. 1158 meters. Coarse grey mud.
Stat. 241. 4° 24′.3 S., 129° 49′.3 E. 1570 meters. Dark sand with small stones.

Type specimen fragmentary, 7.3 cm. long, the proximal part missing. The largest fragment consists of a central straight shaft from which spring four pairs or opposite branches. In two cases there is a third branch origin between the bases of the opposite pairs, showing a tendency toward the formation of verticels so common in this genus, the verticels being 1.4 cm. apart and springing from the horny internodes, which are so narrow that they constitute mere bands.

The branchlets are curved, each consisting of a single calcareous internode varying from 1.3 to 1.8 cm. in length. The calyces are arranged in loose irregular spirals, the distance between their bases being usually from 2 to 4 mm. They are more closely approximated on the distal than on the proximal portions of the branchlets.

The individual calyces are columnar in some cases and obconical in others. A typical calyx is 4 mm. in height, with an average diameter of 1.6 mm., the body being somewhat expanded below. Another is much constricted below, and is 5. mm. in height and 1.7 mm. in diameter at the middle. The columnar form, however, is by far the more common. The calyces project at right angles from the branch, but bend somewhat upward, or distally. Their walls are filled with curved spindles arranged horizontally in the basal parts and obliquely in the distal parts of the walls, those on the abaxial side being larger than those on the adaxial side of the polyp, and extend from the abaxial mid-line upward and obliquely around the calyx walls, somewhat resembling a reversed chevron. The adaxial side is filled with smaller spicules disposed horizontally, in the main.

There is usually a crown of eight well-marked points around the margin, each point consisting of the distal end of a single spicule. The tentacles bear numerous stout, bar-like forms, without any very definite arrangement.

Spicules. These sometimes attain a length of nearly 3 mm., are much more uniform in size than in the other species in the collection, and are much more regularly placed, when in situ, except in case of the tentacular spicules.

Color. The colony, in alcohol, is ivory white, with light, almost white, polyps.

A direct comparison of the Siboga material of this species with a portion of the Challenger type of *A. rigida*, used by Dr. Versluys in his studies, shows that while the two agree well in form of calyces and maximum size of spicules, they differ in comparative uniformity in size of spicules in the calyx walls. The walls of *A. rigida* contain a few comparatively large spicules on the abaxial side, interspersed with others much smaller. In *A. sibogæ* the abaxial wall is filled with a compact series of more slender spindles of comparatively uniform size, without a noticeable admixture of large and small. *A. sibogæ* differs from *A. normani* in the robustness of the calyces and spicules, and from *A. arbuscula* in the same points as from *A. normani*. Indeed, these two latter may be identical.

The present species differs from the next (*A. weberi*) in having much stouter calyces, which are directed outward, and by its marginal crown of points.

2. *Acanella weberi* new species. (Plate III, figs. 1, 1*a*; Plate V, fig. 6).

Stat. 74. 5° 3′.5 S., 119° 0′ E. 450 meters. Globigerina ooze.

Colony arborescent, 18.5 cm. in height. Root consisting of three (originally four) calcareous cylindrical projections pointing downward and outward, all incomplete. Main stem 2.2 cm. long, breaking up into a whorl of branches at its distal end, there being 5 branches in the whorl, with

a 6th slender one in the centre. These branches send off one or two pairs of usually opposite branchlets, the first pair being from 8 to 10 mm. from the bases, the second pair being 9 to 10 mm. above the first. Above these pairs an occasional lateral branchlet is produced, especially toward the distal ends of the branches. Some of the branchlets, however, are simple throughout their length of as much as 12 cm. The branches arise from horny nodes. The calcareous internodes vary in length from the second, which is 3 mm. long, to a length of 14 mm. on the terminal branchlets. The horny nodes vary from the basal one of 2 mm. to about .2 mm. on the terminal twigs.

The diameter of the main stem near the base is 2.5 mm., decreasing to a thread-like axis on distal branchlets. The calyces tend to a biserial arrangement on the branches, but are much more thickly emplanted on distal parts. On the tip of one branch they are thickly emplanted over the surface of an oval object which is probably a parasitic barnacle. The branches are erect, forming a symmetrical and graceful colony.

The individual calyces are club-shaped, and inclined toward the distal end of the colony, sometimes with the adaxial wall contiguous with the branch throughout.

Their adaxial side measures about 2 mm. in length, and their abaxial about 3 mm. Diameter at margin 1.1 mm., at base about .8 mm. The calyx walls are filled with large and small spindles, many of them spirally arranged and more or less bent or wavy. Some of them attain a length of 2.1 mm., or even 3 mm., extending the whole length of the calyx from base to summit. These larger spicules are usually placed on the abaxial wall of the calyx, and sometimes they occur in two series forming a sort of rude inverted chevron on the abaxial wall. There are a few similar but smaller spindles arranged vertically on the adaxial side. While the points of the spindles often extend beyond the margin, they do not form a regular series of eight marginal points such as is found in many other *Isidæ*.

The tentacles are armed with numerous bar-like spicules irregularly placed, but most often transversely disposed.

The cœnenchyma is thin, and contains a few of the large spindles longitudinally disposed, and more numerous small, bar-like forms.

Spicules. These have already been described. Their maximum length, 3 mm., agrees with VERRILL's description of *A. normani* [1], but the manner of branching seems quite distinct. The surfaces of the spicules are covered with fine conical points, evenly distributed.

Color. The colony is white, in alcohol, with the polyps a very light golden brown. The horny nodes of the axis are dark golden brown.

This species is doubtless nearest *A. normani* Verrill; but a direct comparison of the Siboga material with a specimen identified by VERRILL as *A. normani* shows that *A. weberi* differs from *A. normani* in the shape of the calyces, which are much longer and more slender in *A. normani*; and in the spicules, which are much more slender and form a regular crown of points in *A. normani*.

[1] Bulletin of Museum of Comparative Zoology, XI, N° 1, p. 17.

3. *Acanella* sp.?

Stat. 45. 7° 24′ S., 118° 15′.2 E. 794 meters. Fine grey mud.

The specimen consists of a fragment comprising three calcareous internodes joined at their bottom to a horny internode which supports the three. The longest of these internodes is 1.8 cm. long, and the others are nearly as long. Diameter 1.2 mm. The surface is longitudinally grooved or fluted.

This specimen may possibly be *Acanella chilensis*[1] which has the branches arranged in irregular whorls of two or three.

Mopseinæ. (See definition on page 4).

Mopsea Lamouroux.

Mopsea Lamouroux. Histoire des Polypiers coralligènes flexibles, 1816, p. 465.
Mopsea (in part) Ehrenberg. Corallenthiere des Rothen Meeres, 1834, p. 131.
Mopsea Gray. Proceedings Zoological Society of London, 1857, p. 283.
Mopsea Milne Edwards et Haime. Histoire naturelle des Coralliaires, Vol. I, 1857, p. 197.
Mopsea (in part) Dana. Synopsis of the Report on Zoophytes, Wilkes Expedition, 1859, p. 144.
Mopsea Studer. Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin, 1878, p. 665.
Mopsea Studer. Versuch eines Systemes der Alcyonaria, 1887, p. 46.
Mopsea Wright and Studer, Challenger Reports, the Alcyonaria, 1889, pp. XLV, 40.

The original definition for this genus (Lamouroux 1816) is as follows:

"Polypier dendroide à rameaux pinnés: écorce mince, adhérente, couverte de mamelons très petits, elongés, recourbés du côté de la tige, épars ou subverticellés".

Subsequent writers modified this definition so as to admit certain species of *Melithæidæ*, until Studer (1887) defined it as follows:

"Colonie in einer Ebene verzweigt, Polypen klein, keulenförmig, in dichten Spiralen ringsum den Stamm angeordnet. Kelchschuppen klein, niedrig und stachlig".

Wright and Studer (1889) expanded this definition to considerable length on page 40, but give a much shorter definition on page XLV which is practically the same as the one by Studer, quoted above.

"The colony is branched and expanded fan-like in one plane. The polyps are small, club-like in form, and arranged in dense spirals around the stem. The calyx scales are small, short and spiny".

The above definition is the one adopted in this work.

The type species of this genus is *Mopsea encrinula* (Lamarck). Other known species are *M. dichotoma* (Linn.), and the two new species about to be described.

1. *Mopsea flava* new species. (Plate IV, figs. 1, 1*a*; Plate V, fig. 5).

Staf. 117. 1° 0′.5 N., 122° 56′ E. 80 meters. Sand and coral.

Colony strictly flabellate in form, 26 cm. in height, and 17 cm. broad. 3.6 cm. above

[1] Challenger Report, the Alcyonaria, 1889, p. 31.

its base the main stem sends off two opposite branches each bearing branchlets which themselves bear lateral twigs irregularly spaced. Branches of the 4th order are sometimes produced. The main stem, after giving off these branches, continues upward in a wavy course giving off a few lateral branches and ultimate twigs to its distal end. These laterals are very unevenly spaced, but average about 5 mm. apart. Diameter of main stem 5.5 mm., of the lateral twigs 2 mm. The stem and main branches have even surfaces, there being no swellings nor constrictions at the nodes. Proximally the horny nodes are longer than the calcareous internodes, the former being 2.7 mm. long, and the latter 2 mm. Above the origins of the branches, however, the internodes are the longer, being 5.5 mm. long, while the nodes are but 2.2 mm. long. Both nodes and internodes are rather deeply grooved in the main stem, the grooves being numerous and parallel. The branches spring from the calcareous internodes. The polyps are small, and are emplanted on all sides of the larger branches, but tend to be lateral on the smaller twigs. Sometimes, however, they are on all sides, even to the tips of the ultimate branchlets.

The specimen is so completely covered with a parasitic sponge with small needle-like spicules that the details of the individual calyces are hard to ascertain. The calyces are small, and shaped like a truncated cone; or else are dome-shaped verrucæ. A typical one measures 1.3 mm. in height and 1.1 mm. in diameter. The calyx walls are covered with a mosaic of scale-like spicules with ctenate edges nicely fitted together and without regular arrangement in either vertical or transverse rows. The polyp is completely retractile. There are a few very small scales or calcareous granules on the dorsal surface of the tentacles.

Spicules. These are all small, oval or irregular scales, which are densely covered with relatively large tubercles. Occasionally they are somewhat branched, but not extensively so, and the branches are short. Occasionally, also, double heads are seen, and very rarely collar-button forms such as are found in the muriceid genus *Bebryce*. Cœnenchyma covered with similar scales.

Color. The entire colony is a light straw yellow in color, probably brighter yellow in life.

2. *Mopsea alba* new species. (Plate IV, figs. 2, 2*a*; Plate VI, fig. 4).

Stat. 156. 0° 29′.2 S., 130° 5′.3 E. 469 meters. Coarse sand and broken shells.

Colony flabellate in form, attaining a height of 15 mm., and a spread of 20 mm. The main stem arises from a disk-like base and contains one short, unbranched internode 1.2 mm. in length. The other internodes bear branches, except the distal one which is very slender and short. These internodes are 3.5 mm., 8 mm., and 2.9 mm. long, going from the 2nd to the 4th and last. The second internode bears two side branches and the third three. These main branches are rudely alternate and curved upward like candalabra. The lower one bears three curved branchlets, and the third, one. All of the branches arise from calcareous internodes.

The axis is rather faintly grooved, and seems to be hollow; but the specimen was too small to justify dissection to ascertain this point. The polyps are biserial, alternate, and rather distant, being almost 2 mm. apart.

The individual calyces are club-shaped, directed outward basally, and curving upward, or towards the branch termination, distally. A typical one measures 1.6 mm. in height and 1 mm.

across the margin. The calyx walls are covered with numerous small scales transversely disposed, but in numerous rows both vertical and transverse. These scales are very short and broad with their upper exposed edges finely ctenate and apparently overlapping the base of the next scale above. The number of scales in a horizontal row is hard to determine owing to their small size, but there seems to be as many as 20 or more in each row. The tentacles are covered with similar rows of narrow scales fitting the dorsal surface and looking like continuations of the rows on the calyx walls.

Spicules. These are narrow scales with curved and ctenate borders. On the basal parts of the calyces and in the cœnenchyma of the stem and branches they become so narrow as to assume the form of spindless with tuberculate or echinulate surfaces.

Color. The color is almost pure white, in alcohol.

Peltastisis new genus.
(πελταστής and ισις).

Colony unbranched; polyps uniserial and provided with true opercula consisting of eight parts or flaps, each part consisting of a single triangular scale; calyces with spicules of the primnoid type, being flattened scales with irregular branched or ctenate edges and with thorny points on the surface.

The type of this genus is *Peltastisis uniserialis* Nutting. The only other known species, also found in the Siboga collection, is described beyond.

These two species undoubtedly belong to the family *Isidæ*, and can, without violence, be admitted into the subfamily *Mopseinæ*. They are so different, however, from any previously known members of this group that it becomes necessary to construct a new genus for their reception.

The genus *Peltastisis* bridges the narrow gulf between the *Isidæ* and *Primnoidæ* in one important particular in that it combines the jointed axis of the former and the characteristic operculum of the latter, which it also resembles closely in its spiculation. Indeed, it is so directly intermediate between the two families that it can only arbitrarily be placed in either. The character of the axis is, however, of sufficient importance in the opinion of the writer to determine the position of *Peltastisis* as a member of the family *Isidæ*.

1. *Peltastisis uniserialis* new species. (Plate IV, figs. 3, 3*a*; Plate VI, fig. 3).

Stat. 145. 0° 54′ S., 128° 39′.9 E. 827 meters. Hard. Pumice stone.
Stat. 159. 0° 59′.1 S., 129° 48′.8 E. 411 meters. Coarse sand.

Colony consisting of a very delicate unbranched stem growing from a calcareous, lobulated flattened base and attaining a length of 6.2 cm. The basal 1.1 cm. of the stem is devoid of polyps. The basal internode measures 2 mm., the second 2.9 mm., the third and succeeding ones about 3 mm. The horny nodes are very short, about .5 mm., and much narrower than the calcareous ones. The polyps are uniserial and about 1.7 mm. apart, from summit to summit.

The individual calyces are club-shaped or conical, 1 mm. in height on their abaxial side, inclined toward the branch so that the adaxial side is almost contiguous with it. The margin

is even, without evident crown of thorns or other conspicuous ornamentation. The calyx walls are armed with regular imbricating series of oval scale-like plates with ctenate edges and surfaces thickly emplanted with rounded points. There are about seven of these plates on each abaxial row, and two or three on the adaxial rows. Towards the base of the calyx these plates are narrowed and resemble transversely placed spindles. There is a strong operculum of the primnoid type, composed of eight flaps, each flap consisting of a single scale-like spicule. These opercular scales are covered with closely emplanted rounded points, and the entire operculum completely covers the infolded tentacles, there being no spaces between the individual segment or flaps.

Between each pair of adjacent polyps there is a swelling of the cœnenchyma of the branch or stem, the swellings alternating regularly with the polyps and containing ova. The cœnenchyma also contains a layer of rather heavy tuberculate spindles, arranged longitudinally.

Spicules. These are mainly of two types. 1st. the regular spicules of the cœnenchyma. These are spindles the surfaces of which are covered with rather sharp rounded point. 2nd. the scale-like spicules of the calyx walls, which are covered with similar points which, on the edges, give the appearance of a ctenate border. These two types of spicules intergrade on the basal parts of the calyces. The triangular scales forming the opercular segments constitute another, but much more infrequent type.

Color. The colony is almost white, in alcohol, the axis being pure white, and the calyces light brown.

While but a fragment of this very curious form was secured at Station 145, a number of specimens, apparently complete, were dredged from Station 159. The largest specimen was 8.5 cm. long. All are unbranched.

2. *Peltastisis cornuta* new species. (Plate IV, figs. 4, 4*a*; Plate VI, figs. 1, 2, 5).

Stat. 300. 10°48′.6 S., 123°23′.1 E. 918 meters. Fine grey mud.

The type consists of a small fragment, unbranched, 2.9 cm. long. The calcareous internodes vary from the proximal one which is 6.5 mm. long to the distal one which is 5.5 mm. long, decreasing regularly from proximal to distal ends of the specimen. The horny nodes are very short, less than .5 mm. They are more slender than the calcareous internodes, being about .5 mm. in diameter, while the latter are about .7 mm. The calyces are uniserial, quite regularly spaced, being about 2.5 mm. apart and three to each calcareous internode.

The individual calyces are short and thick, shaped like a short, curved club or horn, the distal end being inclined towards the stem or branch, as is characteristic of many of this family and of the *Primnoidæ*. The calyx is about 1 mm. in height (measured directly with dividers), and a little over 1. mm. in diameter across the margin.

The abaxial side of the calyx wall is supported by a most remarkable stay or brace consisting of a comparatively enormous spicule that is bent into a bow-shape so that its distal part is applied longitudinally to the curved abaxial contour of the calyx and its proximal portion is applied to the calcareous internode of the branch in such a manner as to curve downward and partly around it. This stay is therefore unsymmetrically placed as regards the branch, its

proximal part passing around to the right of the midline of the polypiferous surface of the branch. The stay has a smooth surface except at the ends, where it bears numerous nodules, resembling that of the calcareous internodes, and showing ivory white against the darker color of the polyp. It gradually narrows to a point at the proximal end, but is broadened into a shape resembling a shoe-horn at the distal end, the concavity of the "shoe-horn" fitting the curve of the calyx margin to which it is applied. The stay is applied to the entire anterior face of the calyx, ending flush with the margin, and when it is removed it leaves a bare, impressed, band-like space on the abaxial wall, reaching from the base of the calyx to the marginal row of scales which, however, it does not invade. The stay is 1.5 mm. in length, measured with dividers, but would be much longer if measured around the curves.

The calyx walls are covered with minutely ctenate scales greatly resembling those found in several genera of *Primnoidæ*, e.g. *Plumarella* or *Caligorgia*. These scales are arranged in seven or eight vertical rows, except that there is but one scale (the marginal) to each of the adxaxial rows, and there are about eight scales to each abaxial row. The margin is even, without evident lobes, teeth or spines.

The operculum consists of eight segments, each segment consisting of a triangular scale-like spicule neatly fitted to the dorsal surface of a tentacle and with its surface covered with fine rounded nodules. At first view it looks as if each flap is made up of a fine mosaic of many minute plates; but, when separated from the tentacle, it is seen to be a single large thin plate or scale. The cœnenchyma of the branch is thin and contains a layer of longitudinally placed, thin, scale-like spicules which are spindle-shaped in profile, but much flattened. They are ornamented with small, very definite, rounded knobs or points thickly and rather evenly emplanted over the surface. Intermingled with these are clear bar-like and needle-like forms.

About midway between adjacent polyps and on the polypiferous face of the stem or branch are low rounded swellings which contain ova, as in the last species. This is a very exceptional arrangement among the Gorgonacea.

The axis is quite smooth, hard and white. The specimen was so small that it seemed inadvisable to dissect it to determine whether it is hollow or not. A small fragment of a twig termination shows that the axis does not extend to the end of the branch or stem, although this terminal part bears polyps and the strange bracket-like supports for the calyces apparently as well developed as on the proximal parts.

Spicules. These have been already described, and are of several kinds. 1st. The small ctenate scales of the calyx walls. 2nd. The flattened, scale-like spindles of the cœnenchyma. 3rd. The large, thin, triangular plates of the operculum. 4th. The occasional bar-like or rod-like forms in the cœnenchyma, and 5th. The remarkable curved stays or supports on the abaxial faces of the calyces.

Color. The fragment is almost white, with the calyces and ovigerous swellings a medium brown.

DISTRIBUTION OF THE ISIDÆ COLLECTED BY THE SIBOGA EXPEDITION.

List of Stations

at which Isidæ were collected by the Siboga Expedition, and a List of Species collected at each Station.

STATION 45. 7° 24 S., 118° 15'.2 E. 794 meters. Fine grey mud, with some radiolariæ and diatomes. *Acanella* sp.?

STATION 52. 9° 3'.4 S., 119° 56'.7 E. 595 meters. Globigerina ooze. *Ceratoisis philippinensis, Ceratoisis paucispinosa.*

STATION 71. Makassar and surroundings. Up to 32 meters. Mud, sand with mud, coral. *Isis hippuris.*

STATION 74. 5° 3'.5 S., 119° 0' E. 450 meters (chart). Globigerina ooze. *Acanella weberi.*

STATION 85. 0° 36'.5 S., 119° 29'.5 E. 724 meters. Fine grey mud. *Acanella sibogæ.*

STATION 87. 0° 32' S., 119° 39'.8 E. 655 meters. Fine, grey mud. *Ceratoisis wrighti.*

STATION 117. 1° 0'.5 N., 122° 56' S. 80 meters (chart). Sand and coral. *Mopsea flava.*

STATION 122. 1° 58'.5 N., 125° 0'.5 E. Near Menado, Celebes. 1264—1165 meters (chart). Stone. *Ceratoisis philippinensis, Ceratoisis* spec.

STATION 133. Anchorage off Lirung, Salibabu Island. Up to 36 meters. Mud and hard sand. *Isis hippuris.*

STATION 142. Anchorage off Laiwui, coast of Obi Major. 23 meters. Mud. *Isis hippuris.*

STATION 144. Anchorage North of Salomakië (Damar) Island. 45 meters. Coral bottom and Lithothamnion. *Isis hippuris.*

STATION 145. 0° 54' S., 128° 39.9 E. 827 meters. Hard. Pumice stone. *Peltastisis uniserialis.*

STATION 149. Fau anchorage and lagune, West coast of Gebé Island. 31 meters. Coral. *Isis hippuris.*

STATION 156. 0° 29'.2 S., 130° 5'.3 E. 469 meters. Coarse sand and broken shells. *Mopsea alba.*

STATION 159. 0° 59'.1 S., 129° 48'.8 E. 411 meters. Coarse sand. *Peltastisis uniserialis.*

STATION 170. 3° 37'.7 S., 131° 26'.4 E. 924 meters. Fine grey mud. *Acanella sibogæ.*

STATION 173. 3° 27' S., 131° 0'.5 E. 567 meters. Fine yellow grey mud. *Ceratoisis philippensis.*

STATION 178. 2° 40' S., 128° 37'.5 E. 835 meters. Blue mud. *Acanella sibogæ,* ? *Ceratoisis philippinensis.*

STATION 211. 5° 40'.7 S., 120° 45'.5 E. 1158 meters. Coarse grey mud. *Acanella sibogæ.*

STATION 241. 4° 24'.3 S., 129° 49'.3 E. 1570 meters. Dark sand, with small stones. *Acanella sibogæ.*

STATION 258. Tual anchorage, Kei Islands. 22 meters. Lithothamnion, sand and coral. *Isis hippuris.*

STATION 273. Anchorage off Pulu Jedan, East coast of Aru Islands. 13 meters. Sand and shells. *Isis reticulata.*

STATION 279. Ruma-Kuda Bay, Roma Island. 36 meters. Mud and sand. *Isis hippuris.*

STATION 300. 10° 48′.6 S., 123° 23′.1 E. 918 meters. Fine grey mud. *Peltastisis cornuta.*

STATION 301. 10° 38′ S., 123° 25′.2 E. 22 meters. Mud, coral and Lithothamnion. *Isis hippuris.*

STATION 303. Haingsisi, Samau Islands. Up to 36 meters. Lithothamnion. *Isis hippuris.*

It appears from the above list that *Isidæ* were collected at 26 stations during the Siboga Expedition. By far the most widely spread of the species collected, so far as the territory covered by the Siboga is concerned, is *Isis hippuris*, which was secured from 9 stations, over one third of the total number. It is a somewhat remarkable fact that in only two cases (one of which is uncertain) were more than a single species taken from one station; while no station yielded more than two species of *Isidæ*. Contrasted with the 17 species of *Muriceidæ* from Station 310, this seems a decidedly pour showing.

The genus *Isis* is the only one that can be regarded as comprising distinctly shallow water forms, its range being from 22 to 45 meters. All of the other genera are truly inhabitants of the deep water, the bathymetric distribution of the Siboga material being as follows:

Ceratoisis, 595 to 1264 meters; *Acanella*, 450 to 1570 meters; *Mopsea*, 80 to 469 meters; *Peltastisis*, 827 to 918 meters.

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EXPLANATION OF PLATES

The photographs were made from nature by the author.
The spicules were drawn under the camera lucida by Mr. Dayton Stoner.

PLATE I.

Fig. 1. *Isis hippuris* Linnæus. Natural size. 1*a*, part of branch × 5. 1*b*, cross section of axis × 5.
Fig. 2. *Isis reticulata* Nutting. Natural size. 2*a*, part of branch × 5.

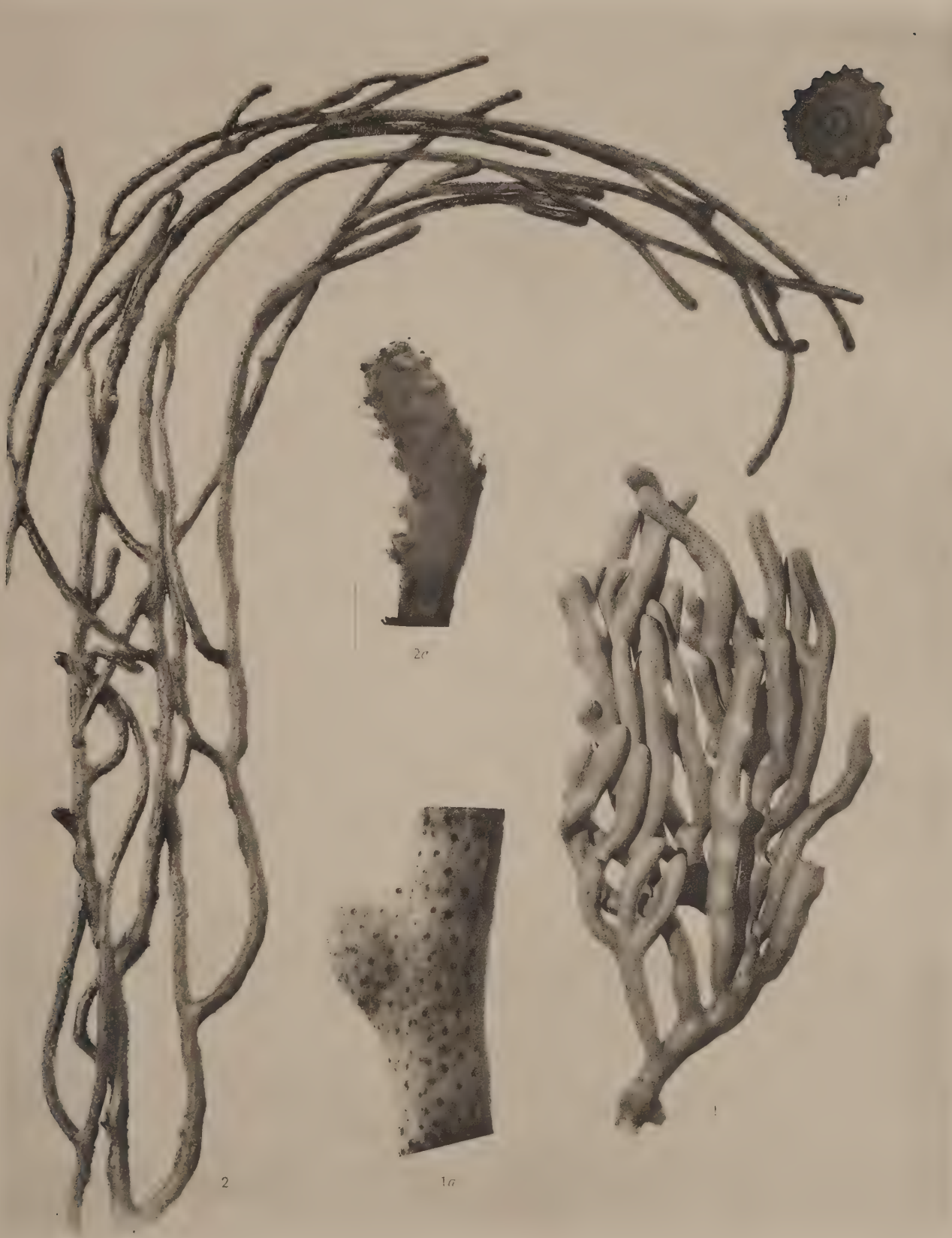

2c
2
1a

PLATE II.

Fig. 1. *Ceratoisis wrighti* Nutting. Natural size. 1*a*, part of stem × 5.

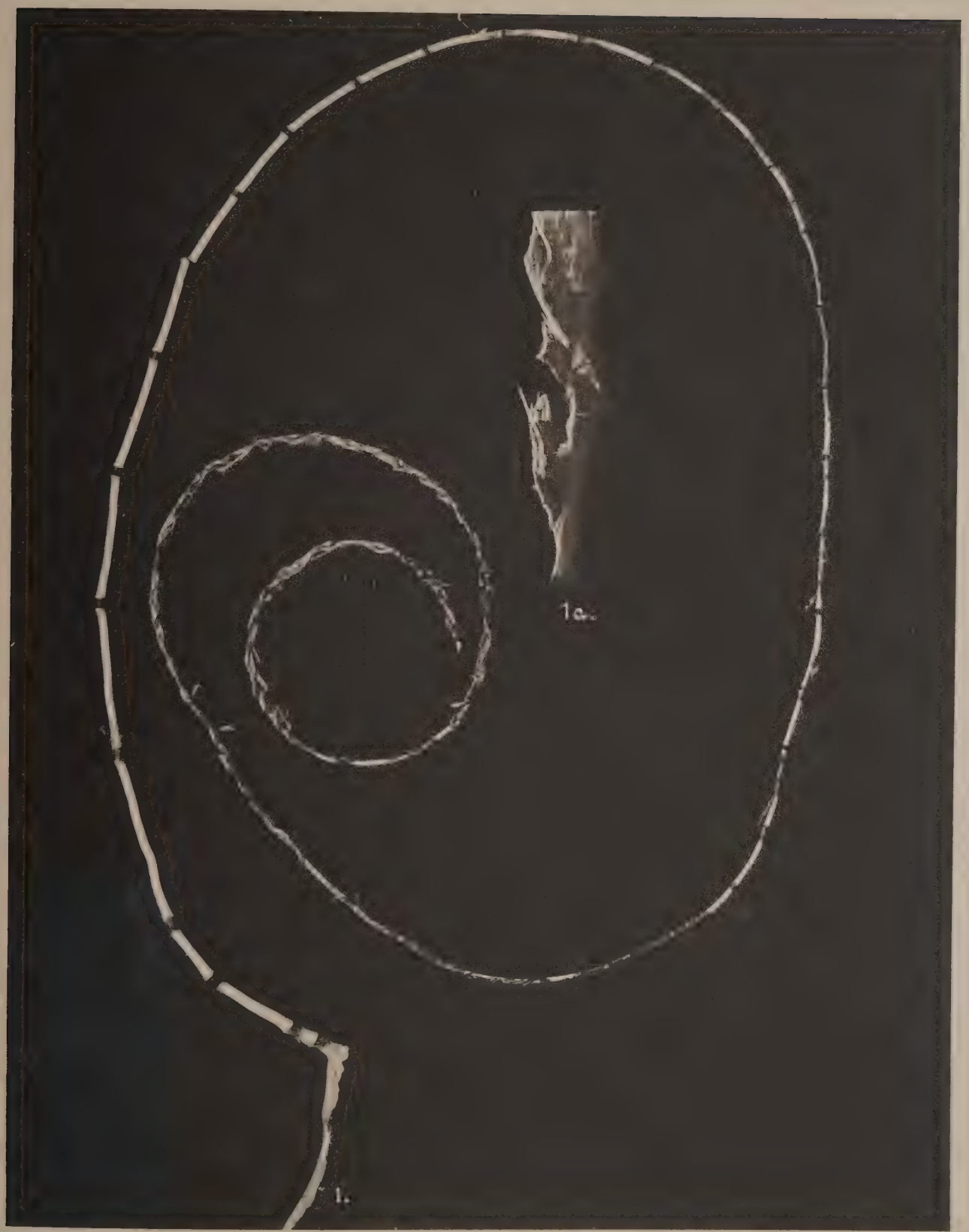

1c.
1.

PLATE III.

Fig. 1. *Acanella weberi* Nutting. Natural size. 1*a*, part of branch × 5.
Fig. 2. *Acanella sibogæ* Nutting. Natural size. 2*a*, part of branch × 5.

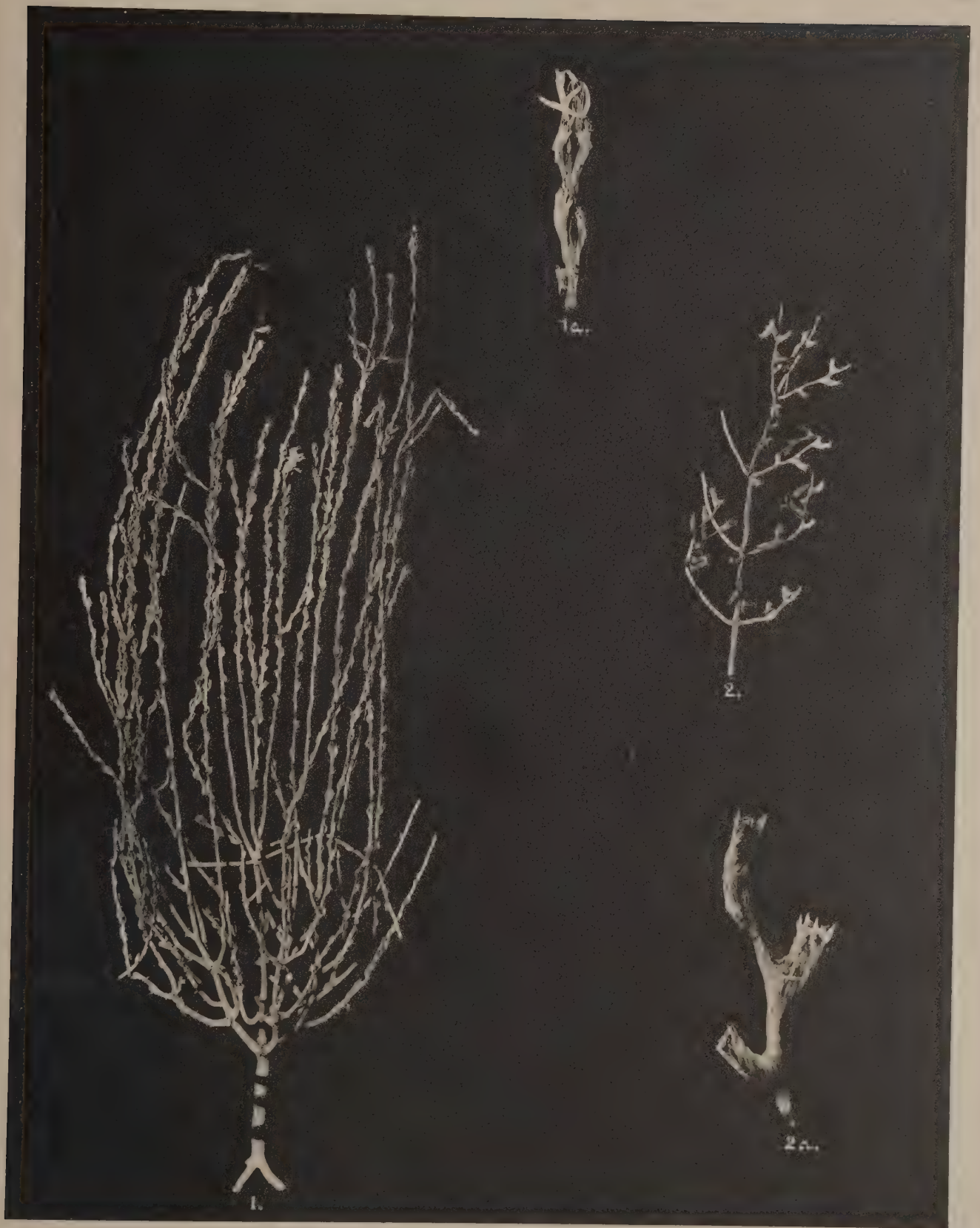

1.
1a.
2.
2a.

PLATE IV.

Fig. 1. *Mopsea flava* Nutting. Natural size. 1*a*, part of branch × 5.
Fig. 2. *Mopsea alba* Nutting. Natural size. 2*a*, branch × 5.
Fig. 3. *Peltastisis uniserialis* Nutting. Natural size. 3*a*, part of stem × 5.
Fig. 4. *Peltastisis cornuta* Nutting. Natural size. 4*a*, part of stem × 5.

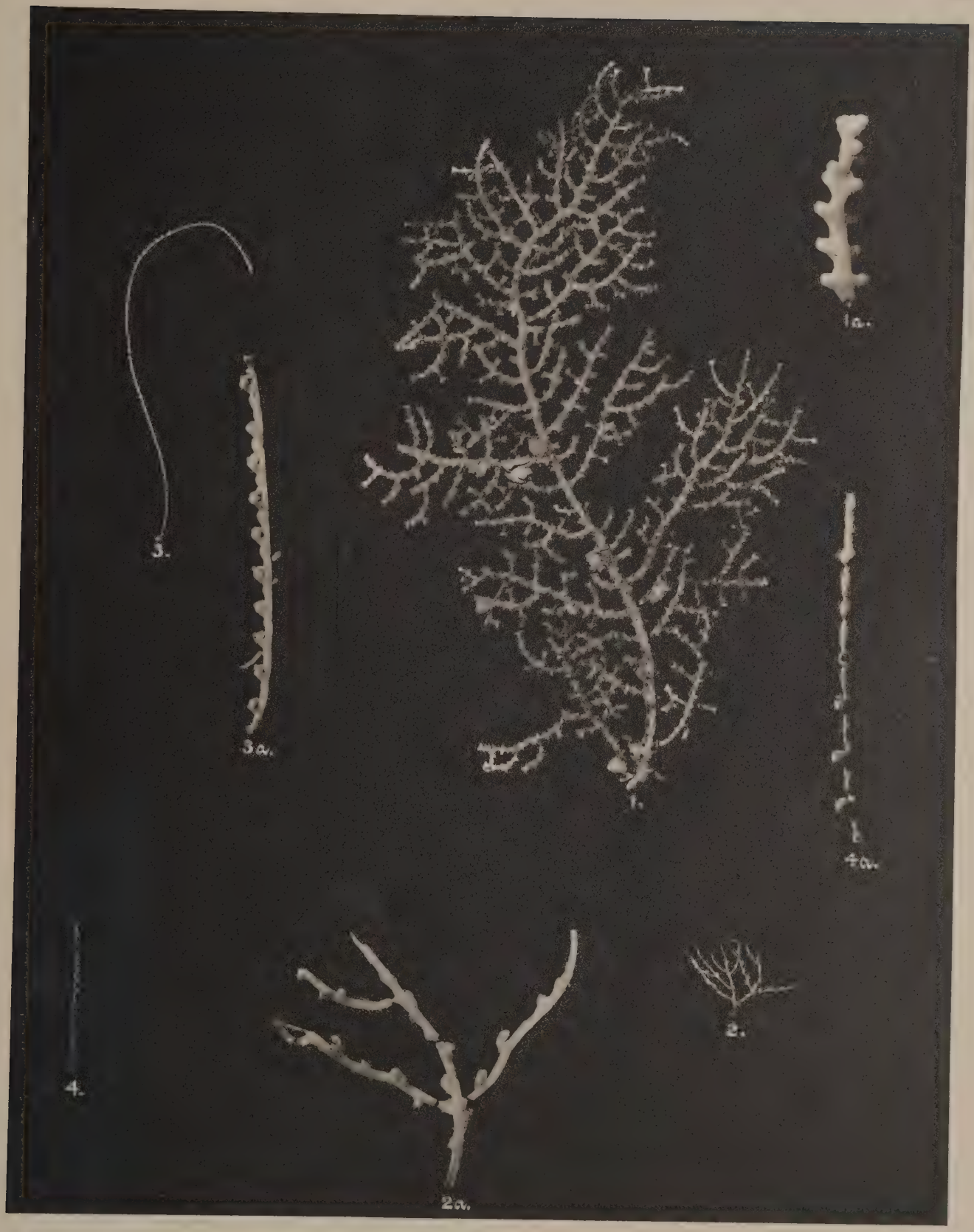
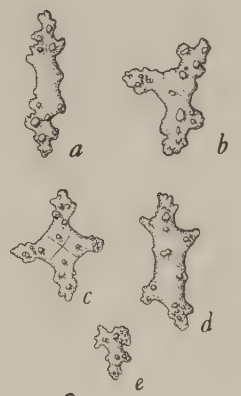

1.
1a.
3.
3a.
4a.
4.
2.
2a.

PLATE V.

Fig. 1. Group of six spicules, *a*, *b*, *c*, *d*, *e*, *f*, of *Isis hippuris* Linn. × 120.
Fig. 2. Group of five spicules, *a*, *b*, *c*, *d*, *e* of *Isis reticulata* Nutting × 120.
Fig. 3. Group of three spicules, *a*, *b*, *c*, of *Ceratoisis wrighti* Nutting × 64. (Approximately one half of each spicule is shown).
Fig. 4. Group of three spicules, *a*, *b*, *c*, of *Acanella sibogæ* Nutting × 120.
Fig. 5. Group of four spicules, *a*, *b*, *c*, *d*, of *Mopsea flava* Nutting × 120.
Fig. 6. Group of three spicules, *a*, *b*, *c*, of *Acanella weberi* Nutting × 120.

1



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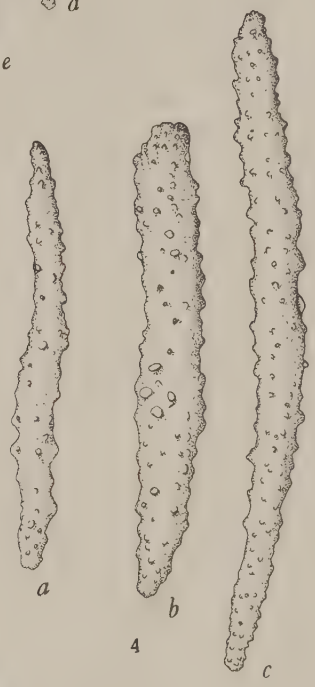

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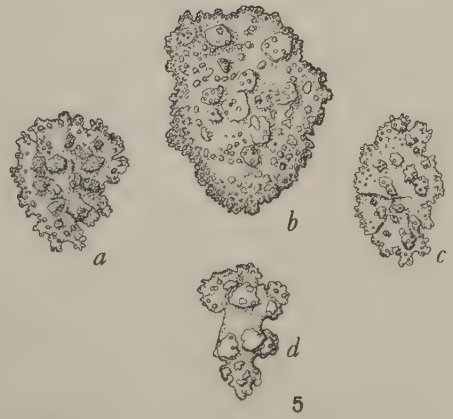

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Jurjan Stoner del

PLATE VI.

Fig. 1. Group of eight spicules of *Peltastisis cornuta* Nutting. *a*, one of the opercular spicules; *b*, one of the spindles of the cœnenchyma; *g*, a spicule intermediate between the calyx scales and the spindles of the cœnenchyma; *c*, *d*, *e*, *f*, *i*, scales from the calyx walls. All × 120.

Fig. 2. One of the "bony stays" consisting of a single peculiar spicule of *Peltastisis cornuta* Nutting × 64.

Fig. 3. Group of five spicules from *Peltastisis uniserialis* Nutting × 120. *e*, one of the characteristic triangular spicules of the operculum; *a*, *b*, *c*, spindles from the cœnenchyma; *d*, calyx scale.

Fig. 4. Group of six spicules, *a*, *b*, *c*, *d*, *e*, *f*, from *Mopsea alba* Nutting × 120.

Fig. 5. Calyx of *Peltastisis cornuta* Nutting × 64. *op.*, opercular scale; *s.* curious "bony stay" which is formed of a single very large spicule and supports the calyx in front.

1

2

3

4

5

Poulton Stamer del